BRITISH STANDARD 476 : Part 4 : 1970

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FIRE TESTS
ON BUILDING MATERIALS AND STRUCTURES

Part 4. Non-combustibility test for materials

BRITISH STANDARDS INSTITUTION

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BS 476 : Part 4 : 1970

Incorporating amendments issued March 1978 (AMD 2483) and September 1983 (AMD 4390)

CONFIRMED JAN 1984

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THIS BRITISH STANDARD, having been approved by the Fire Standards Committee and endorsed by the Chairman of the Building Divisional Council, was published under the authority of the Executive Board on 26 January, 1970.

BS 476 first published in December, 1932.
First revision, 1953,
Part 4 first published January, 1970.

SBN: 580 05694 5

The institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 9,000, fully indexed and with a note of the contents of each, will be found in the BSI Catalogue which may be purchased from BSI Sales Department. The Catalogue may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standard:

BS 4422. Glossary of terms associated with fire.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

As amended Sept., 1983

The following BSI references relate to the work on this standard: Committee reference FSM/1. FSM/1/11 Draft for comment 67/28189

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CO-OPERATING ORGANIZATIONS

The Fire Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

*Board of Trade
County Councils Association
*Department of Employment and Productivity
Fire Extinguisher Trades Association
*Chief Fire Officers' Association
*Fire Offices Committee
*Fire Protection Association
*Greater London Council
Greater London Council (London Fire Brigade)
*Home Office
Industrial Fire Protection Association of Great Britain
Institution of Civil Engineers
*Institution of Fire Engineers
*Institution of Municipal Engineers
*Ministry of Housing and Local Government
*Ministry of Public Building and Works
Ministry of Technology
*Ministry of Technology—Joint Fire Research Organization and Fire Offices Committee
National Council of Building Material Producers
*Royal Institute of British Architects

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Association of British Roofing Felt Manufacturers
British Constructional Steelwork Association
British Fire Services Association
British Plastics Federation
British Rubber Manufacturers Association Ltd.
British Steel Industry
Building Board Manufacturers Association of Great Britain
Confederation of British Industry
Department of Education and Science
Felt Roofing Contractors Advisory Board
Fibre Building Board Development Organisation Ltd.
Gypsum Plasterboard Development Association
Imported Fibre Building Board Federation
Leathercloth and Coated Fabrics Manufacturers
Mastic Asphalt Employers Federation
Ministry of Technology—Forest Products Research Laboratory
National Coal Board
National Federation of Building Trades Employers
Rubber and Plastics Research Association of Great Britain
Timber Research and Development Association
United Kingdom Atomic Energy Authority
Wood Wool Building Slab Manufacturers Association
Individual manufacturers

BRITISH STANDARD

FIRE TESTS ON BUILDING MATERIALS AND STRUCTURES

GENERAL FOREWORD

BS 476 was first published as a single volume in 1932. A revision was published in three parts as follows:

Part 1 : 1953. Fire tests on building materials and structures.
Part 2 : 1955. Flammability test for thin flexible materials.
Part 3 : 1958. External fire exposure roof test.

In the present revision the three sections of Part 1, covering tests for combustibility of materials, surface spread of flame on materials and fire resistance of structures, have been prepared as separate parts and given new part numbers. As each of these parts is issued it will supersede the corresponding section of Part 1. Part 2 : 1955 is being withdrawn as a result of publication of BS 2782, 'Methods of testing plastics', Part 3, 'Miscellaneous methods', which includes Method 508, 'Flammability'. In order to avoid confusion none of the new parts will be numbered 1 or 2. Part 3 : 1958 is under revision. Additional parts for ignitability and fire propagation tests are in preparation.

This in effect means that the standard will comprise the following parts:

Part 3. External fire exposure roof tests.
Part 4. Non-combustibility test for materials.
Part 5. Ignitability test for materials.
Part 6. Fire propagation test for materials.
Part 7. Surface spread of flame test for materials.
Part 8. Fire resistance tests for elements of building construction.

Other tests being studied may result in the issue of further parts.

The need for a glossary covering terms used in BS 476 has been established and this will be published separately as a British Standard glossary of terms and definitions associated with fire.

Part 4. Non-combustibility test for materials

FOREWORD

The present standard replaces the combustibility test specified in BS 476, Part 1, Section 1, 1953 and is issued under the authority of the Fire Standards Committee. The test has been revised and renamed in the light of practical experience in the United Kingdom and of joint investigation and discussion in

an international context. The name ' non-combustibility test ' was thought on balance to be more logical than ' combustibility test ' and in line with the proposals of the International Organization for Standardization (ISO).

Consideration was given to the possibility of using a bomb calorimeter but it was decided not to recommend a test on this basis. The new test recommends that a continuous recording of the furnace temperature is made and requires observations as to whether a sample produces a flame. Materials are classified as combustible or non-combustible by identifying those which make little or no thermal contribution to the heat of the furnace and do not produce a flame, and by calling the remainder ' combustible '.

Three samples are required instead of six as in the earlier test, but the sample size remains practically unchanged. A long steel cone is now attached to the bottom of the testing furnace to act as an air-flow stabilizer.

As part of BSI's programme of metrication this standard is expressed in metric terms.

The metric values are given in SI units. For further information reference should be made to BS 3763* and PD 5686†.

METHOD

1. SCOPE

This British Standard specifies a method of test for determining whether building materials are non-combustible within the meaning of the definition.

Materials used in the construction and finishing of buildings or structures are classified ' non-combustible ' or ' combustible ' according to their behaviour in the ' non-combustibility test '.

This test is intended for building materials‡, whether coated or not, but it is not intended to apply to the coating alone.

2. DEFINITIONS

For the purposes of this British Standard, the definitions given in BS 4422§ apply.

3. SIZE AND NUMBER OF SPECIMENS

Three specimens shall be prepared, each with the following dimensions:

width and breadth	40 mm $\pm \frac{0}{2}$ mm,
height	50 ± 3 mm,
volume	80·0 ± 5·0 cm^3.

* BS 3763, ' International System (SI) units '.
† PD 5686, ' The use of SI units '.
‡ Doubts have been expressed about the validity of the test as applied to materials less than 50 kg/m^3 density and further studies are necessary on the subject.
§ BS 4422, ' Glossary of terms associated with fire ', Part 1, ' The phenomenon of fire '.

4. PREPARATION OF SPECIMENS

If the thickness of the material is less than the height as specified in Clause 3, each specimen shall be made of a sufficient number of layers to achieve this thickness. These layers shall occupy a horizontal position in the specimen holder and shall be held together firmly, without compression, by means of fine steel wires to prevent air gaps between layers. The density of the specimen shall be representative of the density of the material.

For composite materials of a thickness such that an integral number of layers cannot be put together to give a specimen of the specified size (see Clause 3), the specimen shall be prepared to the required thickness by adjusting the thicknesses of the different components so that their proportions in the specimen shall be the same as those in the material. If it is not possible to follow either procedure in the preparation of the specimens, tests shall be performed on the individual component layers of the material and reported accordingly.

5. CONDITIONING OF SPECIMENS

Before test, the specimens shall be dried in a ventilated oven at 60 ± 5 °C for 24 h and then cooled to ambient temperature in a desiccator containing anhydrous calcium chloride.

6. APPARATUS

6.1 General. Before the commencement of a test it is necessary to ensure that the air stabilizer is internally clean. The apparatus shall not be placed in a part of the laboratory where it might be exposed to draughts, or to lighting which would make observation of flaming difficult.

6.2 Furnace. The apparatus shall be a tubular electric furnace comprising a tube of refractory material of a density between 1500 and 3200 kg/m³, an internal diameter of 75 mm, a height of 150 mm and an overall wall thickness between 10 and 13 mm. The furnace shall be located within an insulated surround as shown in Fig. 1. *As amended March, 1978*

To the underside of the furnace shall be attached a cone-shaped air-flow stabilizer, 500 mm long and reducing from 75 mm internal diameter at the top to 9 mm internal diameter at the lower end. The stabilizer cone shall be made of steel sheet, approximately 1 mm thick, and finished smooth on the inside, particular attention being given to the joint with the furnace, which should be a close, airtight fit and finished smooth internally. At the open top of the furnace a draught shield shall be provided; it shall be made of the same material as the stabilizer cone, with an internal diameter of 75 mm and a height of 50 mm.

The electric winding of the furnace shall be so arranged that a vertical zone of at least 60 mm length in the central part of the empty furnace maintains the operating temperature, uniform to within ± 10 °C as measured by the *As amended Sept., 1983*

thermocouple located 10 mm from the wall (see Fig. 2). This uniformity can be achieved either by having closer windings at the two ends of the furnace tube or by means of separate windings at the two ends regulated independently of the central section. To minimize temperature fluctuations in the furnace it is necessary to use a voltage stabilizer in the circuit able to maintain voltage within ±0·5 % of the nominal value.

NOTE. When the furnace is mounted on a stand with the lower end of the air flow stabilizer near floor level, draughts are likely to disturb the air flow in the furnace and lead to temperature fluctuation. This can be overcome by the provision of shields, consisting of boards 4–5 mm thick, fixed around the stand to a height of approximately 550 mm from the floor.

6.3 Specimen holder and insertion device. The specimen shall be placed in a holder made of nichrome or heat resisting steel wire of 1·0–1·5 mm diameter, a fine metal gauze tray of heat resisting steel being placed in the bottom, as shown in Fig. 3. The weight of the holder assembly shall not exceed 20 g. This holder shall be suspended from the lower end of an adjustable tube of heat resisting steel, which has an outside diameter of approximately 6 mm and an internal diameter of 2 mm. The specimen insertion device shall consist essentially of a metallic rod moving freely in a vertical tube fitted to the side of the furnace, the heat resisting steel tube with the specimen holder being fixed by means of a space bar to the sliding rod. This device shall be so designed and operated that the specimen is inserted into the furnace quickly and without any mechanical shock. During the test the specimen holder shall occupy a predetermined position in the furnace, in the middle of the constant temperature zone and equidistant from the walls.

As amended March, 1978

6.4 Temperature measurement. Mineral-insulated stainless-steel-sheathed thermocouples shall be used, having an external diameter of 1.5 mm, with nickel/chromium v. nickel/aluminium thermocouple elements of 0.3 mm nominal diameter. The junction shall be of the insulated type.

The furnace thermocouple shall be located in its correct position by means of small steel spacers attached to the top and bottom edges of the draught shield and having 2·3 mm diameter holes. For temperature observation it is desirable to use a temperature recorder, say of 1000 degC range, which will give a continuous measurement during the test.

The temperature measuring equipment shall have an accuracy of at least 0·5 %.

7. TEST PROCEDURE

The test shall be carried out in the furnace described in Clause 6. The furnace temperature shall be measured by the thermocouple, positioned so that its

hot junction is 10 mm from the wall of the furnace and at mid-height of the specimen. A second thermocouple shall be placed in the centre of the specimen, inserted from the top through a 2 mm diameter hole drilled, where necessary, for this purpose. This shielded thermocouple shall maintain contact with the material at the bottom.

The furnace shall be heated and its temperature stabilized at 750 ± 10°C for a minimum period of 10 min. The specimen shall then be inserted in the furnace, the whole operation being performed in not more than 5 s. A record shall be made for a further 20 min of the temperature of the two thermocouples by means of a continuous recorder; the occurrence and duration of any flaming in the furnace shall be noted. The stabilized heating current shall be maintained unchanged for the period of the test.

8. DESIGNATION OF NON-COMBUSTIBILITY

The material shall be deemed non-combustible if, during the test, none of the three specimens either

(1) causes the temperature reading from either of the two thermocouples to rise by 50 degC or more above the initial furnace temperature, or

(2) is observed to flame continuously for 10 s or more inside the furnace.

Otherwise, the material shall be deemed combustible.

9. TEST REPORT

The test report shall include the following information:

(1) Name or identification mark of material.
(2) Brief description of material.
(3) Density of material.
(4) Date of receipt of material.
(5) Date or dates of test.
(6) Test results.
(7) Designation of material as combustible or non-combustible, according to the test criteria.

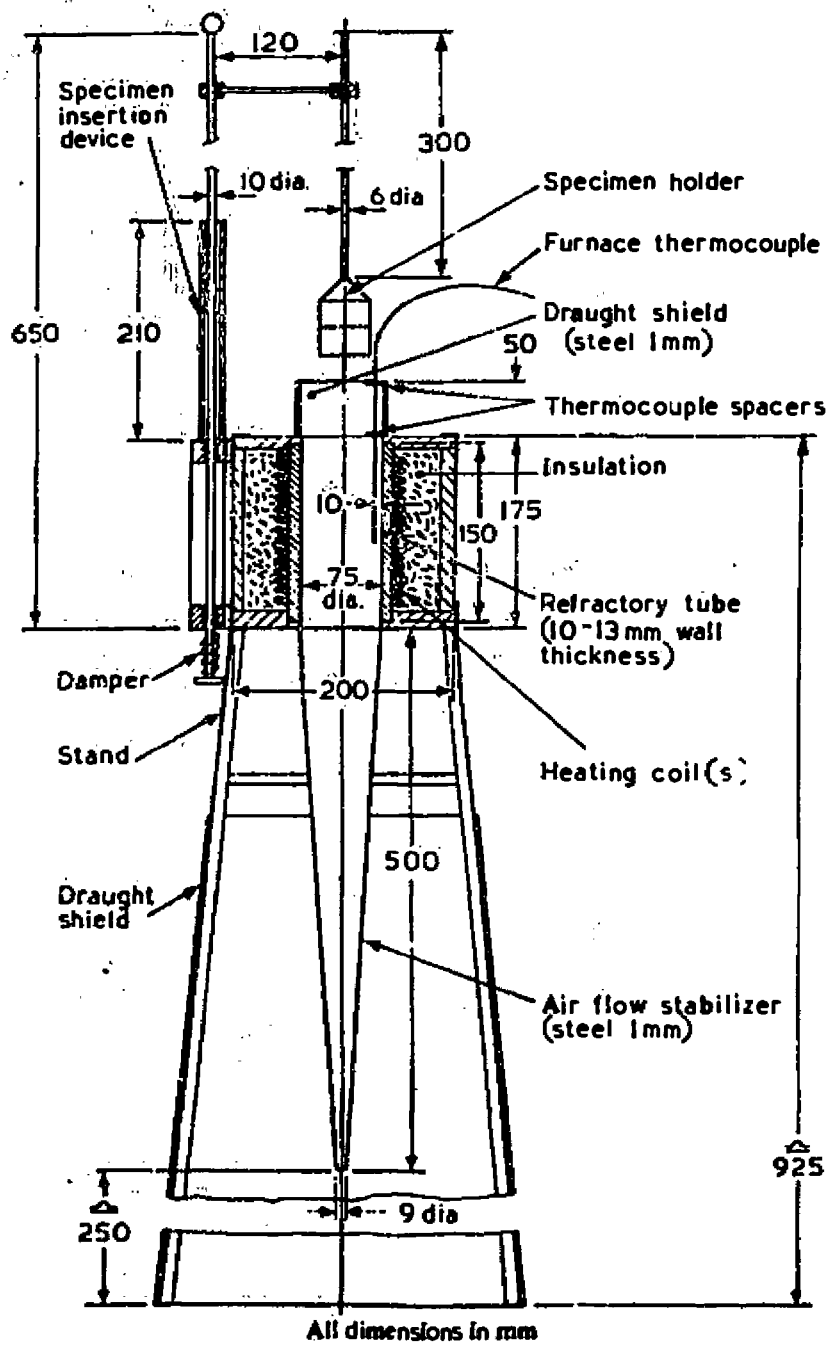

Fig. 1. General arrangement of non-combustibility apparatus

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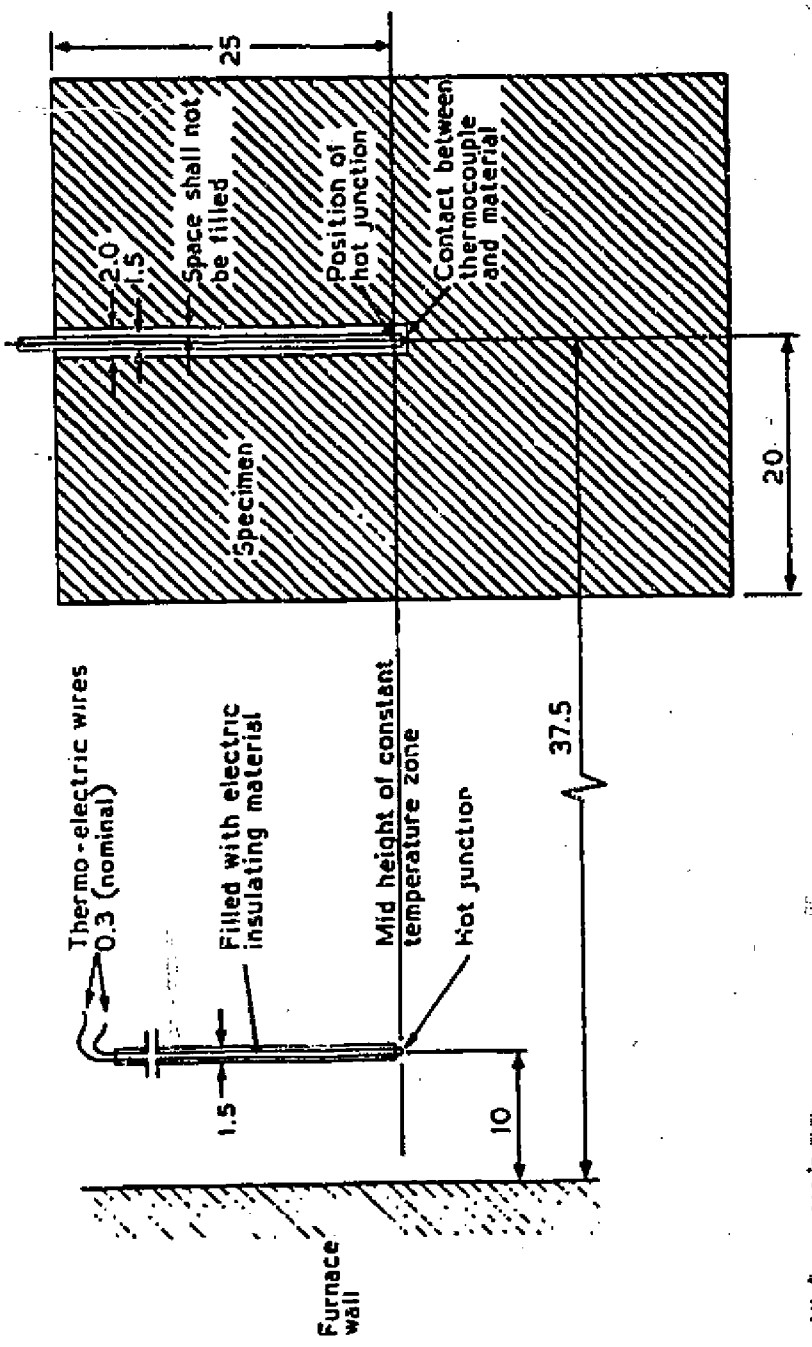

All dimensions in mm

Figure 2. Furnace and specimen thermocouple
As amended March, 1978

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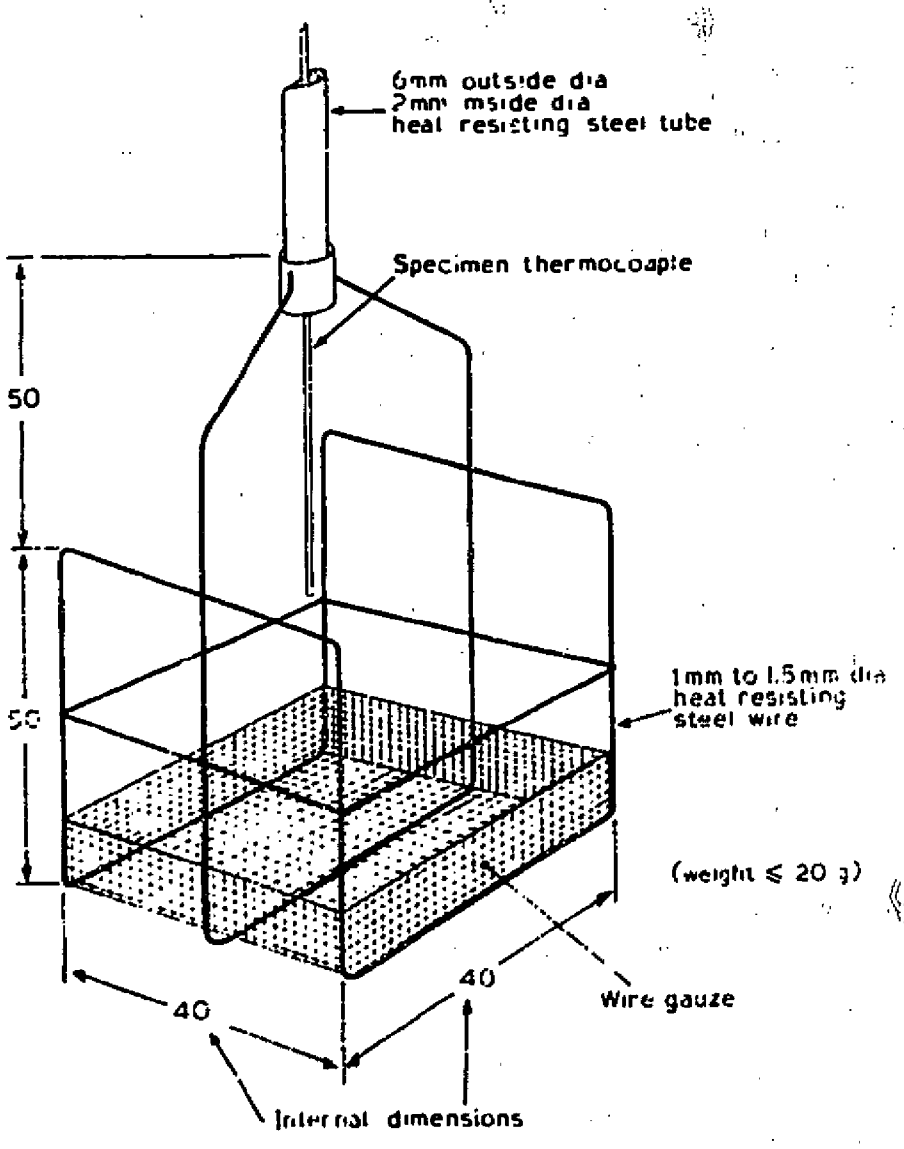

All dimensions in mm

As amended March, 1978

Figure 3. Specimen holder

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